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RESEARCH ARTICLE

A new species of *Clinodiplosis* (Diptera: Cecidomyiidae) causing galls on *Banisteriopsis membranifolia* (Malpighiaceae), an endemic plant in Brazil

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ABSTRACT. *Clinodiplosis quartelensis* **sp. nov.** (holotype male in MNRJ: Brazil, Minas Gerais State), a new gall midge species causing leaf galls on *Banisteriopsis membranifolia* (A. Juss.) B. Gates (Malpighiaceae), an endemic liana in Brazil, is described based on larva, pupa, adult male and female and its gall is characterized. Galls were collected in Quartel de São João, state of Minas Gerais, Southeastern Brazil. Larvae were removed from the galls and pupae and adults were obtained by rearing. Pupation takes place in the gall. The most important morphological characters were illustrated. The new species is compared with other Neotropical species of *Clinodiplosis* and belongs to the group with simple tarsal claws, curved beyond tarsus midlength. *Clinodiplosis quartelensis* **sp. nov.** shares the male cercus secondarily lobed, the 12th female flagellomere with setulose apical process, the deeply bilobed male hypoproct with convergent lobes, pupa lacking dorsal spines on abdominal segments, and larva with four pairs of setose terminal papillae with *C. bellum* from that might be distinguished by size of palpus, wing venation, level of sclerotization of eighth abdominal segment in the adults, as well as, by the pupal cephalic dorsal plate and larval spatula.

KEY WORDS. Atlantic Forest, gall, insect-plant interaction, Malpighiaceae.

INTRODUCTION

Banisteriopsis C.B.Rob. ex Small is one of the most diverse genera of Malpighiaceae. It is well represented in Brazil, where 47 species of 58 from the New World are found (Gates 1982). *Banisteriopsis membranifolia* (A. Juss.) B. Gates is an endemic liana in Brazil, occurring in the Atlantic Forest (states of Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo) and Amazon (state of Amazonas) (Mamede 2017). This liana hosts a leaf gall, which is induced by a new species of midge of the genus *Clinodiplosis* Kieffer, 1894 (Diptera, Cecidomyiidae) herein described.

Clinodiplosis is a cosmopolitan genus with 107 species (Gagné and Jaschhof 2017). Among them, 24 exhibit a Neotropical distribution and 19 occurring in Brazil. In spite of being associated with about 32 plant families, only a single species has been recorded on Malpighiaceae, *Clinodiplosis bellum* Urso-Guimarães & Carmo-Neto, 2015 from Cerrado in the state of São Paulo, Brazil. The new species of *Clinodiplosis* described here is the second species associated with this plant family in the world.

The genus is characterized by the presence of occipital process; four–segmented palpi; wings with 1–3 mm long, R5 joining C beyond the wing apex, Rs weaker than R1, but evident; variable tarsal claws (toothed or simple, and curved near basal third or beyond), empodia usually reaching the curve of the claws or sometimes shorter; quadrate or secondarily lobed or acute male cerci; aedeagus usually elongate and tapering to the apex or sometimes large and bulbous; ovipositor short, barely protrusible; and female cerci separate (Gagné 1994).

The objective of this study is to describe a new species of *Clinodiplosis* associated with *Banisteriopsis membranifolia*, contributing to the knowledge of its diversity in the Neotropics.

MATERIAL AND METHODS

The field work was done in the municipality of Quartel São João, State of Minas Gerais (Southeastern Brazil) at 45°43'59"W, 19°10'13"S, 924 m of altitude. This area harbors

threatened species of birds (Freitas et al. 2009, Moura et al. 2011) and it is considered as priority for conservation (Drummond et al. 2005).

Several specimens of *Banisteriopsis membranifolia* were found in March, 2009. Reproductive branches (with flowers and fruits) were collected, pressed and dried. The botanical species was identified by MSc Andreia Fonseca Silva and a voucher specimen deposited in the "Herbário da Empresa de Pesquisa Agropecuária de Minas Gerais", Belo Horizente, Brazil (PAMG/EPAMIG: 56333).

Galled branches were removed from the host plant and transported in plastic bags to laboratory. Some samples were dissected to obtain the galling larvae and others were kept in plastic pots covered by a fine-meshed screen to obtain adults and pupal exuviae.

The specimens were first preserved in 70% ethanol, then mounted on microscope slides, following the methods outlined by Gagné (1994) and deposited in the Entomological Collection of the Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ).

The genus was identified based on the key of Gagné (1994). As there is no key for species of *Clinodiplosis*, we compared the morphology of the new species with all Neotropical species based on the type material deposited in the MNRJ and literature data (original descriptions and drawings presented by Gagné 1994).

TAXONOMY

Clinodiplosis quartelensis sp. nov.

http://zoobank.org/F6A09D66-040F-492B-98F0-8719DD12E79D
Figs 1–12

Diagnosis. Flagellomere 12 with apical process, setulose in both sexes; tarsal claws simple and curved beyond basal third; male cerci secondarily lobed; gonostyli 8–9 times as long as wide; aedeagus elongate, tapering to the apex and constricted subapically; pupa with antennal basis well projected, cervical sclerite bilobed at the middle of the superior margin, abdominal dorsal spines absent, larva with spatula with long stalk and four pairs of setose terminal papillae.

Material examined. Holotype male. Brazil, Minas Gerais State: Quartel São João municipality, III.2009, L. Oliveira leg. Paratypes, same locality, data and collector: 3 males, 9 females, 7 pupal exuviae and 15 larvae. All deposited in MNRJ.

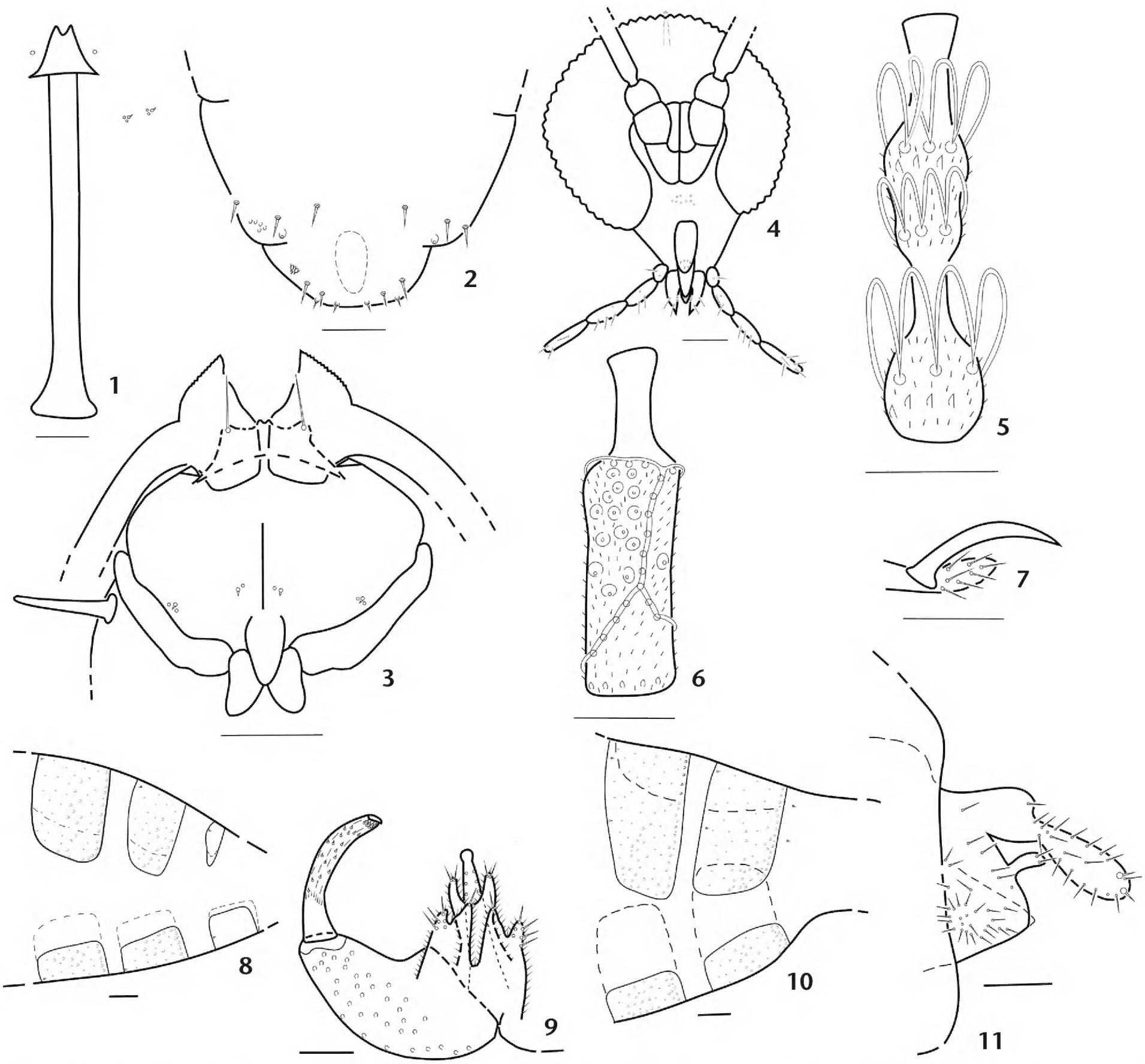
Larva. Fusiform and cylindrical body; 2.60–3.85 mm long (n = 11). Integument rough. Spatula (Fig. 1): 0.22–0.35 mm long (n = 11), two-toothed, apical teeth triangular with rounded apex, stalk narrow, except basally, very long, about 6.5 times as long as anterior part of spatula. Two groups of three lateral papillae on each side of spatula (one pair setose in each group) (Fig. 1). Terminal segment (Fig. 2) with four pairs of terminal papillae: one pair with setae as long as dorsal setae of eight abdominal segment, one pair with setae about half as long, two pairs with short setae.

Pupa. Body length: 3.25–3.95 mm (n = 6). Head (Fig. 3): cervical sclerite bilobed at the middle of the superior margin, apical setae 0.10–0.13 mm long (n = 10); antennal basis with superior margin pronounced in a conspicuous horn-like process; two pairs of lower facial papillae, one pair with seta and another lacking setae, three pairs of lateral facial papillae, one pair with seta and two lacking setae. Prothoracic spiracle (Fig. 3) elongate 0.18–0.26 mm long (n = 9), digitiform. Abdominal segments 2–8 without conspicuous spines.

Adult. Body length: 2.90–3.40 mm in male (n = 3), 3.40–4.30 mm in female (n = 9). Head (Fig. 4): occipital process present. Eye facets hexagonal, all closely approximated. Antenna: scape subcylindrical, pedicel spheroid, both with few setae and scarce scales, male flagellomeres binodal and tricircumfilar, nodes setulose and necks bare; circumfila loops regular in length (Fig. 5); male flagellomere 5: 0.15–0.18 mm long (n = 4), basal node 4.1–5.8 times shorter than the total length of the flagellomere, basal neck 5.3–8.6 times shorter than the total length of the flagellomere, distal node 2.5–3.0 times shorter than the total length of the flagellomere, and distal neck 3.2–3.6 times shorter than the total length of the flagellomere; female flagellomeres cylindrical, node setulose and neck bare; flagellomere 5: 0.18–0.20 mm long (n = 8), node 2.7–3.3 times shorter than the total length of the flagellomere, circumfila as two connected horizontal rings (Fig. 6). Flagellomere 12 with apical process, setulose in both sexes. Frontoclypeus with 6–8 setae in male (n = 4), 6–10 in female (n = 5). Labrum triangular, long-attenuate, with 3 pairs of ventral sensory setae. Hypopharynx shorter than labrum, with anteriorly directed lateral setulae. Labella 0.07–0.09 mm long (n = 9), elongate-convex, each with long lateral setae and three pairs of short mesal sensory setae. Palpus 0.18–0.28 mm long in male (n = 4), 0.28–0.34mm in female (n = 6) with four crescent cylindrical segments, all with setae.

Thorax. Wings: length: 2.15–2.55 mm in male (n = 5), 3.05–3.35 mm in female (n = 8); venation: R1 2.22–3.04 times shorter than wing length, Rs evanescent, R5 curved, joining C beyond wing apex, M3 evanescent; CuA forked. Scutum with 4 longitudinal rows of setae with a few scales intermixed, the 2 dorsocentral rows broadest anteriorly and as single row on posterior half of sclerite, the 2 lateral rows in double row continuous along length of scutum. Scutellum with abundant setae, absent mesally. Anepisternum with a few scales dorsally; anepimeron with 7–14 setae (n = 5); other pleura bare. Tarsal claws simple, bent beyond midlength, gradually attenuate to apex; empodium short, not reaching bent in claws (Fig. 7).

Male abdomen (Fig. 8): tergites 1–7 rectangular with distal row of setae, setae irregularly distributed at midlength and laterally, anterior pair of trichoid sensilla, and mostly covered elsewhere with scales; eight tergite narrow, sclerotized with only anterior pair of trichoid sensilla as vestiture. Stern-



Figures 1–11. *Clinodiplosis quartelensis* sp. nov. (1–2) larvae in ventral view: (1) spatula, sternal and lateral papillae, scale bar 0.03 mm; (2) 8–9th abdominal segments, scale bar 0.10 mm; (3) pupa: cephalic region and prothoracic spiracle, scale bar 0.20 mm; (4–11) Adults: (4) male head in frontal view, scale bar 0.20 mm; (5) male flagellomere 5, scale bar 0.05 mm; (6) female flagellomere 5, scale bar 0.05 mm; (7) male hindleg, tarsal claw and empodium, scale bar 0.0 2mm; (8) male 6–8th abdominal segments in lateral view, scale bar 0.10 mm; (9) male terminalia in dorsal view, scale bar 0.05 mm; (10) female 6–8th abdominal segments in lateral view, scale bar 0.10 mm; (11) ovipositor in lateral view, scale bar 0.05 mm.

ites 2–8 rectangular, with distal row of setae, setae irregularly distributed at midlength and laterally, anterior pair of trichoid sensilla, and mostly covered elsewhere with scales. Trichoid sensilla of sternites more closely approximated than those of tergites. Mesal and lateral setae of sternites more numerous than those of tergites.

Male terminalia (Fig. 9): gonocoxite 0.23–0.25 mm long and 0.09–0.10 mm wide, 1.90–2.50 as long as wide, 1.15–1.35 times longer than gonostylus (n = 4), cylindrical, with triangular mesal lobe; gonostylus 0.18–0.20 mm long and 0.02–0.03 mm wide, 8–9x as long as wide (n = 4), elongate, slightly constricted at midlength, striate at distal 2/3 and setulose at

Figure 12. Galls of *Clinodiplosis quartelensis* sp. nov on *Banisteriopsis membranifolia* (Malpighiaceae).

basal 1/3; cercus setose and secondarily lobed, inner lobe longer than outer lobe; hypoproct deeply concave apically, each resulting lobe widely separated from each other and with two apical setae; aedeagus elongate, tapering from basis to apex, constricted subapically, with rounded apically.

Female abdomen (Fig. 10): tergites and sternites 1–7 rectangular as in male; eight tergite not sclerotized, with only anterior pair of trichoid sensilla as vestiture.

Ovipositor barely protrusible, female cerci (Fig. 11) elongate-ovoid and setose, with apical pair of seta stronger than the others, hypoproct narrow, elongate with two apical setae.

Gall (Fig. 12). On abaxial leaf surface, isolated or in groups near the veins, pear-shaped, with a basal peduncle and an apical reddish spine-like projection, green, glabrous, one-chambered, occupied by a single larva and with rigid wall.

Etymology. The name *quartelensis* refers to the locality where the specimens from the new species were collected.

Remarks. *Clinodiplosis* includes adults with simple or toothed tarsal claws, curved at their basal third or beyond midlength. The new species has simple claws, curved beyond midlength. Only five Neotropical species exhibit simultaneously both characters, i.e.: *C. alternantherae* Gagné, 2004, *C. bellum* Urso-Guimarães & Carmo-Neto, 2015, *C. cattleyae* Molliard, 1903, *C. conica* Oliveira & Maia, 2008 and *C. eupatorii* (Felt, 1911).

Among those five species, only *C. bellum* and *C. quartelensis* have the male cercus secondarily lobed. Other resemblances between these species are: the setulose apical process in the 12th female flagellomere; the deeply bilobed male hypoproct with convergent lobes; the elongate, tapering to the apex and constricted subapically aedeagus; the obtuse mesobasal lobe of the gonocoxites; pupa lacking dorsal spines on abdominal segments; and larva with no corniform papillae. Adults of both species can be distinguished by the length and proportions among the segments of the palpus (longer with crescent segments in *C. quartelensis* **sp. nov.**), wing venation (presence of M_4 only in *C. quartelensis* sp. nov.), and level of sclerotization of male 8th tergite (sclerotized only in the new species). Furthermore, the pupa of *C. quartelensis* sp. nov. differs from that of *C. bellum* mainly by the superior margin at the middle of cephalic dorsal plate narrow bilobed (wide with the entire superior margin at the middle in *C. bellum*). In addition the spatula is missing in *C. bellum*.

The host plant, *Banisteriopsis membranifolia*, is an endemic plant in Brazil. Considering that 92% of the Brazilian fauna of Cecidomyiidae are monophagous (Carneiro et al. 2009), the new galling species probably is endemic too.

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